

CLAIMS

1. Liquid crystal display with wide viewing angle comprising nematic liquid crystal with negative dielectric anisotropy placed between flat parallel substrates supplied with conductive electrodes and homeotropic aligning layers,
5 characterized in that orientation of the said liquid crystal is made non-uniform within the pixel area by means of the parallel to the said substrates components of the electric field applied to the said electrodes, while the components themselves have various directions.
- 10 2. Display according to claim 1, characterized in that the doubled product of the liquid crystal thickness by its birefringence is made equal to the odd number of the light wavelengths.
3. Display according to claim 1, characterized in that the said liquid crystal contains chiral dopant in such amount, that equilibrium pitch of the said liquid crystal equals
15 four times the thickness of the liquid crystal layer.
4. Display according to claim 3, characterized in that the said thickness of the liquid crystal layer is made so that its doubled product with the birefringence of the said liquid crystal equals odd number of the wavelengths of light.
5. Display according to claim 1, characterized in that one of the said electrodes is made
20 reflective.
6. Display according to claim 1, characterized in that the said electrodes are made of not similar dimensions.
7. Display according to claim 1, characterized in that at least one of the said electrodes is made sectional.
- 25 8. Display according to claim 1, characterized in that odd and even sections of the said electrodes are connected to the electric field sources of the opposite polarity.
9. Display according to claim 1, characterized in that in the space occupied by the said liquid crystal dielectric particles are displaced with dielectric constant essentially different from dielectric permittivity of the said liquid crystal.
- 30 10. Method for making liquid crystal display with wide viewing angle comprising the deposition on conductive electrodes and homeotropic aligning layers of the faced to each other surfaces of the flat parallel substrates and filling the space between them with nematic liquid crystal possessing negative dielectric anisotropy,

characterized in that

when electric field is applied to the said electrodes the components of the electric field parallel to the said substrates with various directions are created and due to this orientation of the said liquid crystal in the space between the said electrodes is made non-uniform.

11. Method according to claim 10, characterized in that the doubled product of the liquid crystal thickness by its birefringence is chosen to be equal to the odd number of the light wavelengths.

12. Method according to claim 10, characterized in that chiral dopant is added to the said liquid crystal in such amount, that equilibrium pitch of the said liquid crystal is made equal four times the thickness of the liquid crystal layer.

13. Method according to claim 12, characterized in that the doubled product of the birefringence of the said liquid crystal by its thickness is chosen to be equal odd number of the wavelengths of light.

14. Method according to claim 10, characterized in that one of the said electrodes is made reflective.

15. Method according to claim 10, characterized in that the said parallel to the substrates plane component of the electric field is created due to non-similarity of the dimensions of the said electrodes.

16. Method according to claim 10, characterized in that the said parallel to the substrates plane component of the electric field is created by making at least one of the said electrodes sectional.

17. Method according to claim 10, characterized in that the said parallel to the substrates plane component of the electric field is created by connecting odd and even sections of the said electrodes to the electric field sources of the opposite polarity.

18. Method according to claim 10, characterized in that the said parallel to the substrates plane component of the electric field is created by displacing in the space occupied by the said liquid crystal dielectric particles with dielectric constant essentially different from dielectric permittivity of the liquid crystal.

THE LIQUID CRYSTAL DISPLAY WITH WIDE VIEWING ANGLE AND
METHOD FOR MAKING IT

5 The present invention relates generally to the field of electronics and may be used for making displays and, in particular, liquid crystal information displays, panels, cells e.t.c.

The object of invention is to simplify the method for making liquid crystal devices by reducing the number of technological operations and consequently to reduce the cost
10 of liquid crystal display without sacrificing the quality (wide viewing angle).

To achieve this the electric field applied to the liquid crystal in such display has the non-uniform component parallel to the plane of the substrates, which leads to the non-uniform reorientation of the aforementioned liquid crystal in the space between the
15 aforementioned electrodes within the pixel area and hence improves optical properties of this display in various directions of observation.

AMENDED CLAIMS

[received by the International Bureau on 12 November 1998 (12.11.98);
original claims 1-18 replaced by new claims 1-16 (3 pages)]

- 5 1. Liquid crystal display with wide viewing angle comprising nematic liquid crystal with negative dielectric anisotropy placed between flat parallel substrates supplied with conductive electrodes and homeotropic aligning layers, orientation of the said liquid crystal is made non-uniform within the pixel area by means of the parallel to the said substrates components of the electric field applied to the said electrodes, while
- 10 the components themselves have various directions characterized in that in the space occupied by the said liquid crystal dielectric particles are displaced with dielectric constant essentially different from dielectric permittivity of the said liquid crystal.
- 15 2. Display according to claim 1, characterized in that the said dielectric particles are made by depositing relieved dielectric films over the aforementioned electrodes.
- ~~3. Display according to claim 1, characterized in that the doubled product of the liquid crystal thickness by its birefringence is made equal to the odd number of the~~
- 20 ~~light wavelengths.~~
4. Display according to claim 1, characterized in that the said liquid crystal contains chiral dopant with such concentration that equilibrium pitch of the said liquid crystal equals four times the liquid crystal thickness and the product of the later by the liquid crystal birefringence is made equal to the integer number of the light
- 25 wavelengths.
5. Display according to claim 1, characterized in that one of the said electrodes is made reflective.
6. Liquid crystal display with wide viewing angle comprising nematic liquid crystal with negative dielectric anisotropy placed between flat parallel substrates
- 30 supplied with conductive electrodes and homeotropic aligning layers, orientation of the said liquid crystal is made non-uniform within the pixel area by means of the parallel to the said substrates components of the electric field applied to the said electrodes, while the components themselves have various directions

characterized in that

odd and even sections of the at least one of the said electrodes been made sectional
5 are connected to the electric field sources of the opposite polarity.

~~7. Display according to claim 6, characterized in that the doubled product of
the liquid crystal thickness by its birefringence is made equal to the odd number of the
light wavelengths.~~

8. Display according to claim 6, characterized in that the said liquid crystal
10 contains chiral dopant with such concentration that equilibrium pitch of the said liquid
crystal equals four times the liquid crystal thickness and the product of the later by the
liquid crystal birefringence is made equal to the integer number of the light
wavelengths.

9. Display according to claim 6, characterized in that one of the said electrodes
15 is made reflective.

10. Method for making liquid crystal display with wide viewing angle
comprising the deposition on conductive electrodes and homeotropic aligning layers of
the faced to each other surfaces of the flat parallel substrates and filling the space
between them with nematic liquid crystal possessing negative dielectric anisotropy,
20 making the orientation of the said liquid crystal in the space between the said
electrodes non-uniform when applying the electric field to the said electrodes with the
components of the electric field parallel to the said substrates with various directions
characterized in that
the said parallel to the substrates plane component of the electric field is created by
25 displacing in the space occupied by the said liquid crystal dielectric particles with
dielectric constant essentially different from dielectric permittivity of the liquid crystal.

11. Method according to claim 10, characterized in that the said dielectric
particles are made by depositing relieved dielectric films over the aforementioned
electrodes.

30 12. Method according to claim 10, characterized in that the doubled product of
the liquid crystal thickness by its birefringence is chosen to be equal to the odd number
of the light wavelengths.

13. Method according to claim 10, characterized in that chiral dopant is added
to the said liquid crystal with such concentration that equilibrium pitch of the said

liquid crystal equals four times the liquid crystal thickness and the product of the later
by the liquid crystal birefringence is made equal to the integer number of the light
5 wavelengths.

14. Method for making liquid crystal display with wide viewing angle
comprising the deposition of conductive electrodes and homeotropic aligning layers on
the faced to each other surfaces of the flat parallel substrates and filling the space
between them with nematic liquid crystal possessing negative dielectric anisotropy,
10 making the orientation of the said liquid crystal in the space between the said
electrodes non-uniform when applying the electric field to the said electrodes with the
components of the electric field parallel to the said substrates with various directions
characterized in that
the said parallel to the substrates plane component of the electric field is created by
15 connecting odd and even sections of the said electrodes been made sectional to the
electric field sources of the opposite polarity.

~~15. Method according to claim 14, characterized in that the doubled product of
the liquid crystal thickness by its birefringence is chosen to be equal to the odd number
of the light wavelengths.~~

20 16. Method according to claim 14, characterized in that chiral dopant is added
to the said liquid crystal with such concentration that equilibrium pitch of the said
liquid crystal equals four times the liquid crystal thickness and the product of the later
by the liquid crystal birefringence is made equal to the integer number of the light
wavelengths.

Add A'

STATEMENT UNDER ARTICLE 19(1)

The amendments have been made since the prior art cited in the International Search Report contains the features present in the original Claims.

The original claims 1, 6, 7, 15, 16 have been canceled because the features of these claims fully coincide with the features known from the above prior art.

The original claims 2, 3, 4, 5, 8, 9, 11, 12, 13, 14, 17, 18 have been amended and substituted with the new claims 1-16.

In the new independent claims 1, 6, 10 and 14 the features of the original claims 9, 8, 18 and 17 accordingly have been used.

In the new claims 3 and 7 the features of the original claim 2 have been used, in the new claims 5 and 9 the features of the original claim 5 have been used, in the new claims 12 and 15 the features of the original claim 11 have been used.

In the new claims 3 and 8 the features of the original claims 3 and 4 and of the disclosure have been combined.

In the new claims 13 and 16 the features of the original claims 12 and 13 and of the disclosure have been combined.

The new claims 2 and 11 have been created on the basis of disclosure.